

Fig. 1

Equation Number	Chemical Equation	Remarks
EQ 1	$2 \text{Al} + 3\text{H}_2\text{O} \rightarrow \text{Al}_2\text{O}_3 + 3\text{H}_2 + 946.2 \text{ (KJ/mol)}$	Explosive event, hydrogen gas produced
EQ 2	$2\text{Al} + 3\text{CuO} \rightarrow \text{Al}_2\text{O}_3 + 3\text{Cu} + 1203.0 \text{ (KJ/mol)}$	Non-explosive event, no gaseous product
EQ 3	$\text{C}_3\text{H}_6\text{O}_6\text{N}_6 \rightarrow 0.77\text{CO}_2 + 2.23\text{CO} + 2.23\text{H}_2\text{O} + 0.77\text{H}_2 + 3\text{N}_2 + 1145.76 \text{ (KJ/mol)}$	RDX decomposition by detonation
EQ 4	$2\text{Al} + 3\text{CO}_2 \rightarrow \text{Al}_2\text{O}_3 + 3\text{CO} + 820.6 \text{ (KJ/mol)}$	CO_2 as a detonation product
EQ 5	$2\text{Al} + 0.77\text{CO}_2 + 2.23\text{H}_2\text{O} \rightarrow \text{Al}_2\text{O}_3 + 0.77\text{CO} + 2.23\text{H}_2 + 914.0 \text{ (KJ/mol)}$	Complete reaction between RDX detonation products and Al
EQ 6	$x\text{Al} + 0.385x\text{CO}_2 + 1.115x\text{H}_2\text{O} \rightarrow 0.5x\text{Al}_2\text{O}_3 + 0.385x\text{CO} + 1.115x\text{H}_2 + 457.0x \text{ (KJ/mol)}$	Complete reaction between RDX detonation products and x moles of Al, $0 \leq x \leq 2$
EQ 7	$\text{C}_3\text{H}_6\text{O}_6\text{N}_6 + x\text{Al} \rightarrow (0.77 - 0.385x)\text{CO}_2 + (2.23 + 0.385x)\text{CO} + (2.23 - 1.115x)\text{H}_2\text{O} + (0.77 + 1.115x)\text{H}_2 + 3\text{N}_2 + 0.5x\text{Al}_2\text{O}_3 + (1145.76 + 457.0x) \text{ (KJ/mol)}$	Complete reaction between 1 mole of RDX and x moles of Al, $0 \leq x \leq 2$
EQ 8	$\text{C}_3\text{H}_6\text{O}_6\text{N}_6 + x\text{Al} \rightarrow 3\text{CO} + 3\text{H}_2\text{O} + 3\text{N}_2 + \text{Al}_2\text{O}_3 + x\text{Al} + 2060.0 \text{ (KJ/mol)}$	RDX/Al mixture to produce Al in molten state, $x \geq 2$
EQ 9	$2\text{Al} + 3\text{NH}_4\text{NO}_3 \rightarrow \text{Al}_2\text{O}_3 + 6\text{H}_2\text{O} + 3\text{N}_2 + 2023.43 \text{ (KJ/mol)}$	AN dissolved in water to increase reactivity and to decrease Al temperature for complete chemical reaction
EQ 10	$3\text{CuO} + x\text{Al} \rightarrow \text{Al}_2\text{O}_3 + 3\text{CuO} + (x - 2)\text{Al} + 1024.0 \text{ (KJ/mol)}$	CuO/Al mixture to produce Al in molten state, $x \geq 2$
EQ 11	$\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe} + 846.0 \text{ (KJ/mol)}$	Thermite reaction, mixture used to produce Al in molten state when Al is surplus in stoichiometry

Fig. 2

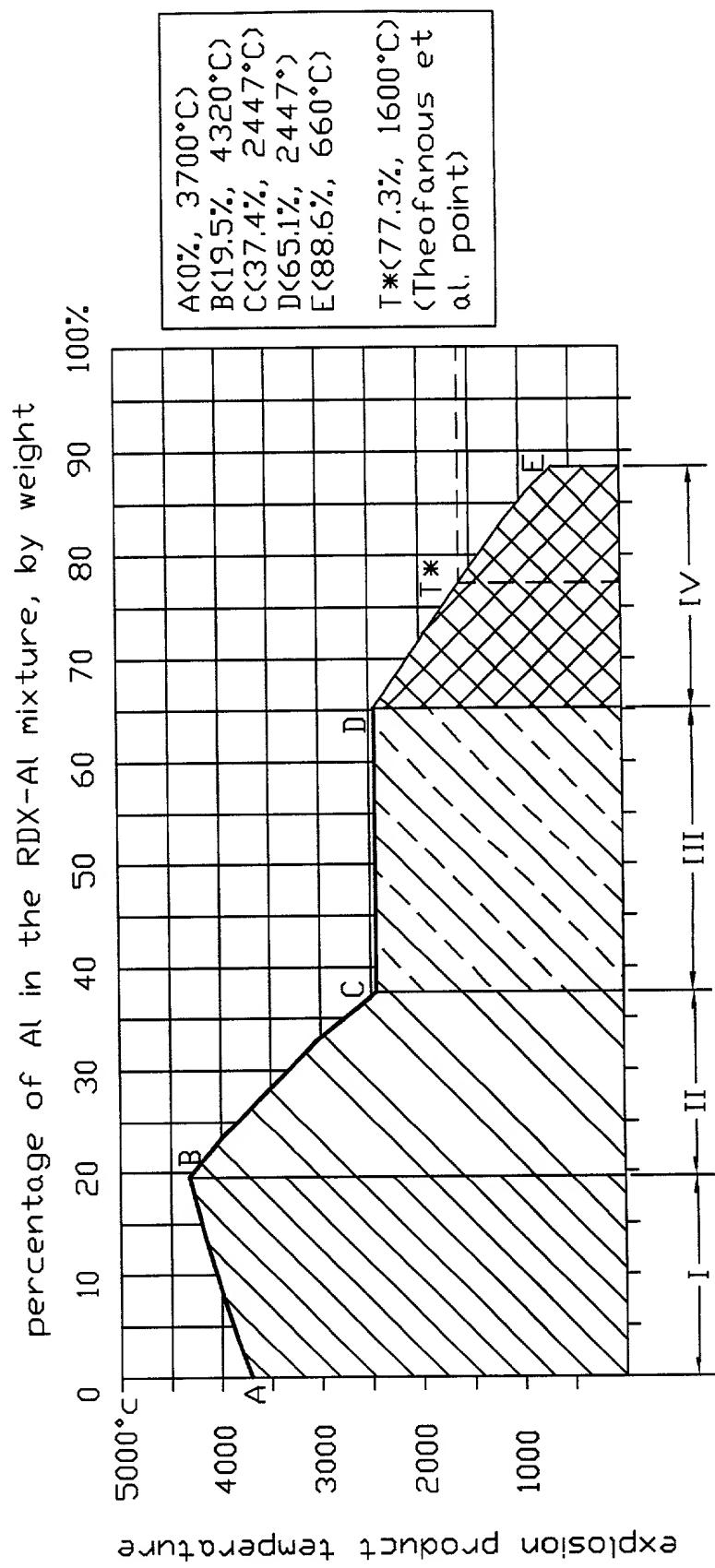


Fig. 3

Name of Oxygen Carrier	Molecular Formula	Oxygen Balance	Solubility in Water	Decomp. Temp.	Remarks
Sodium Nitrate	NaNO_3	47% (Na_2O , N_2)	84.5 g/100 ml (20°C)	380°C	Used as oxidizer in propellant, commercial explosives and black powder
Potassium Nitrate	KNO_3	39.6% (K_2O , N_2)	38.5 g/100 ml (25°C)	400°C	Used in pyrotechnics, commercial explosives, black powder, propellants and matches
Barium Nitrate	$\text{Ba}(\text{NO}_3)_2$	30.6% (BaO , N_2)	8.7 g/100 ml (20°C)	800°C	Used as oxidizer in propellants and pyrotechnics
Ammonium Nitrate	NH_4NO_3	20% (H_2O , N_2)	192 g/100ml (20°C)	210°C	Well-known fertilizer. Used in propellants and commercial explosives
Lithium Perchlorate, LP	LiClO_4	60.2% (LiCl)	59.7 g/100ml (25°C)	400°C	Used as oxidizer in rocket and missile propellant
Potassium Perchlorate	KClO_4	46.19% (KCl)	18.2 g/100ml (100°C)	530°C	Used as oxidizer in rocket propellant and in explosives
Strontium Perchlorate	$\text{Sr}(\text{ClO}_4)_2$	44.64% (SrCl)	309.7 g/100ml (25°C)	477°C	Used as oxidizer in propellants
Ammonium Perchlorate	NH_4ClO_4	34.04%	20 g/100ml (25°C)	200~300°C (low temperature decomposition)	Predominantly used as oxidizer in solid propellants for missiles and rockets
Potassium Chlorate	KClO_3	39.17%	56.2 g/100ml (100°C)	400°C	Used with fuel to make explosives, also used in pyrotechnics and match head
Sodium Chlorate	NaClO_3	45.10%	100 g/100ml (20°C)	melting point 248°C	Moisture absorbing, not very often used in explosives

Fig. 4

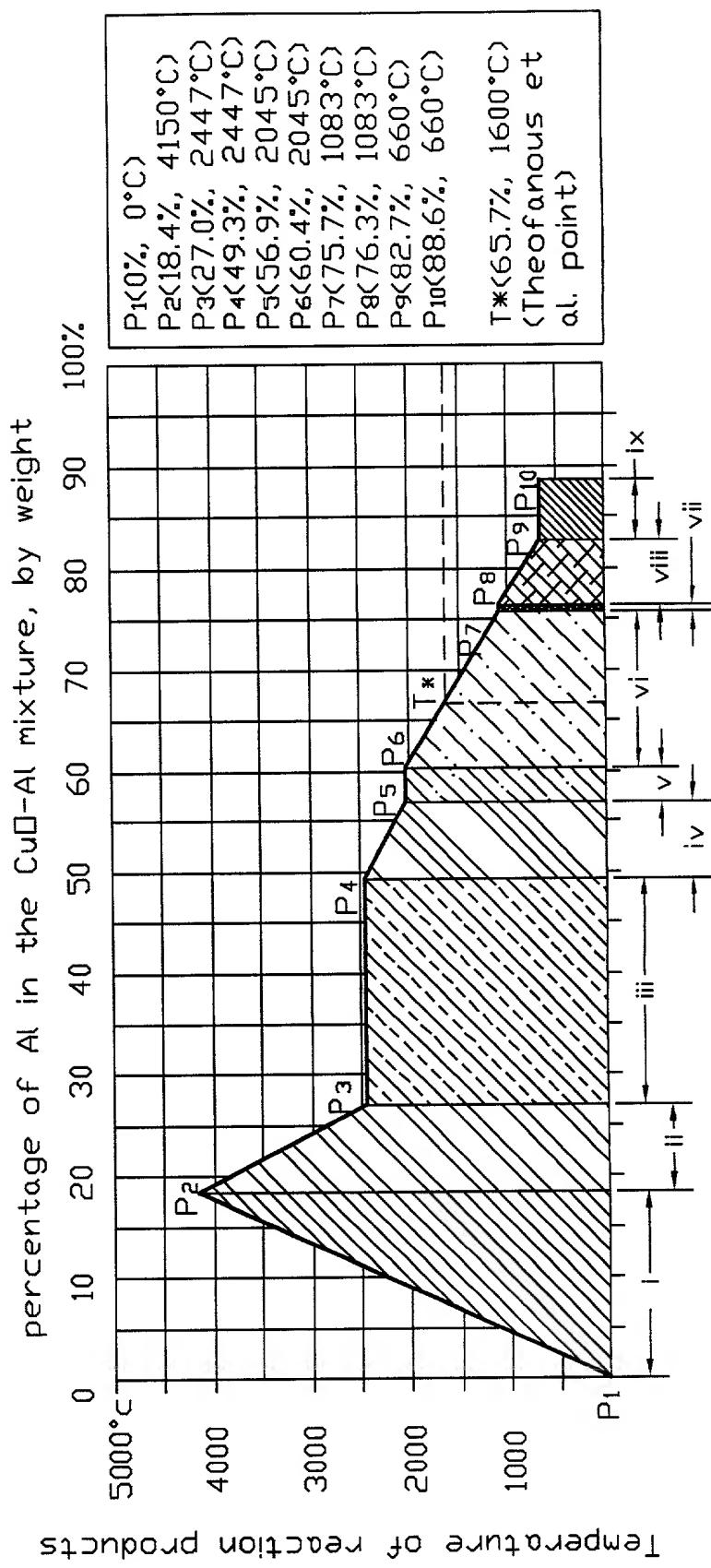


Fig. 5

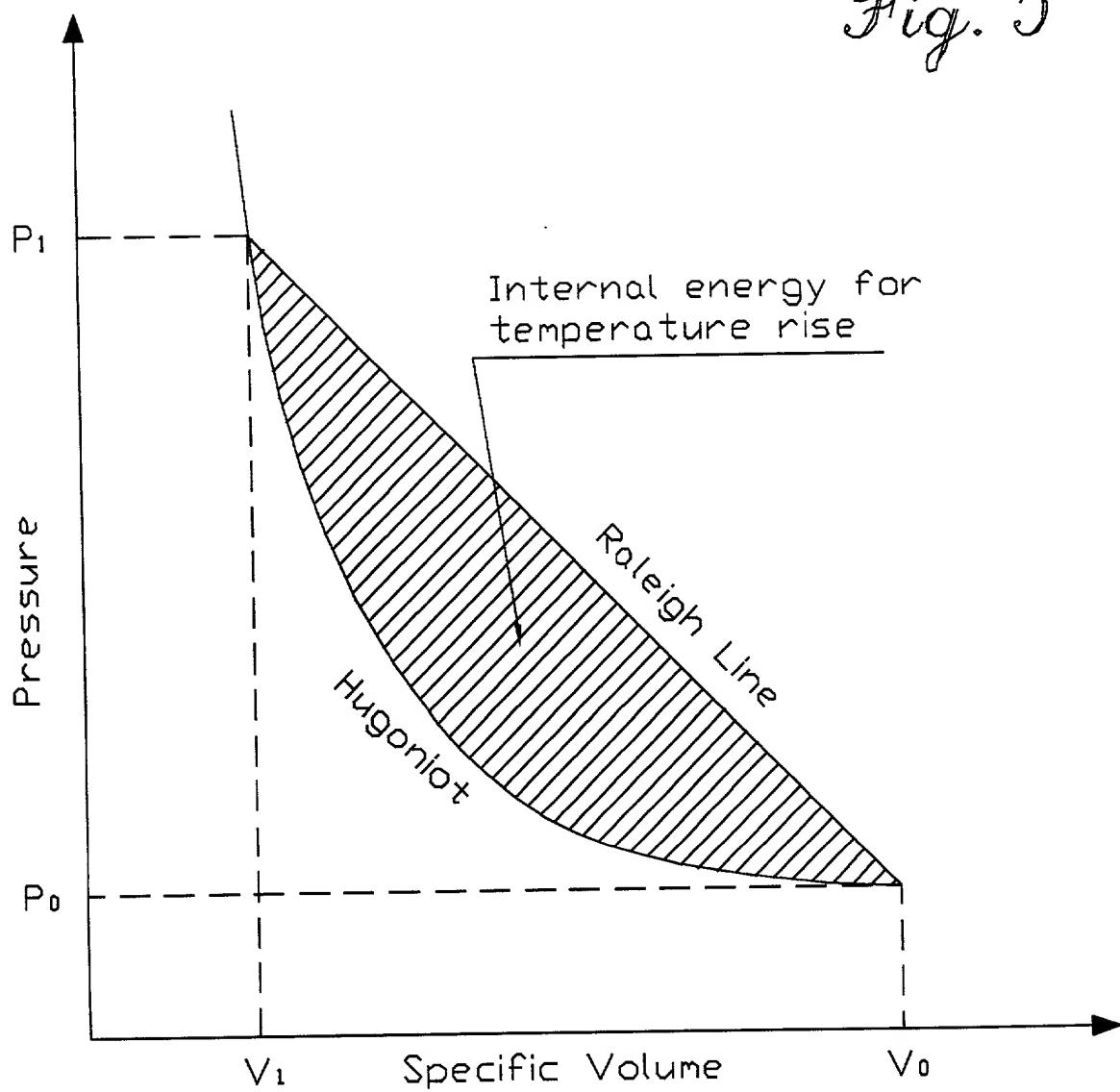


Fig. 6

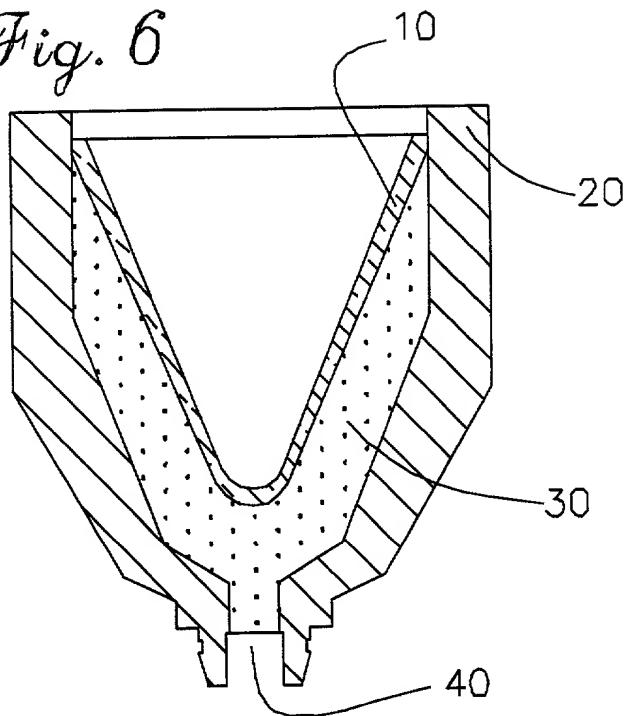


Fig. 7

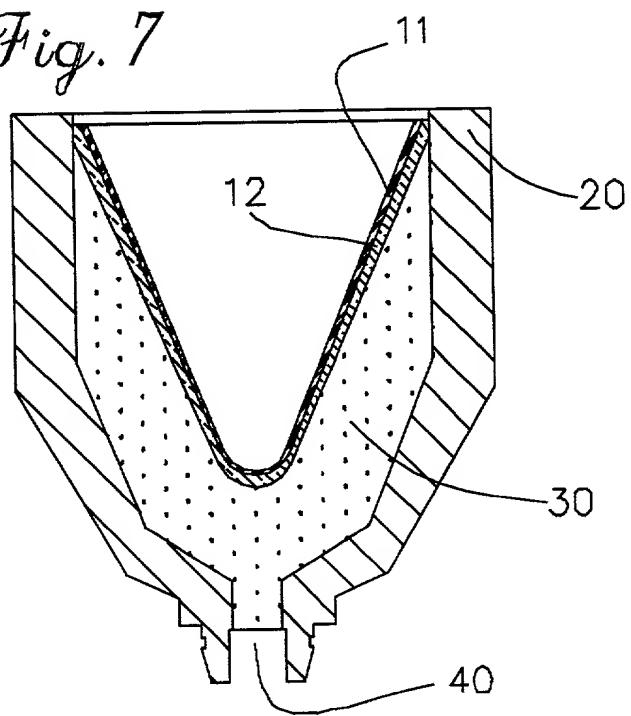
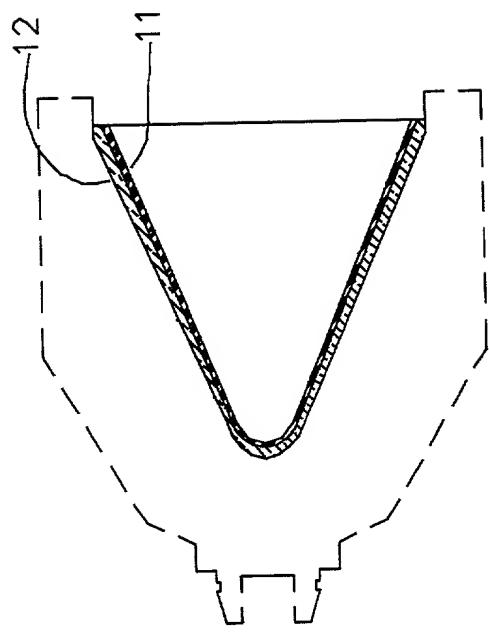


Fig. 8 (a)



(b)

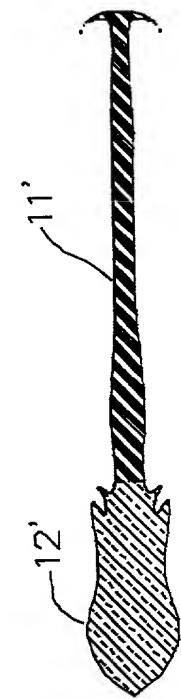


Fig. 9

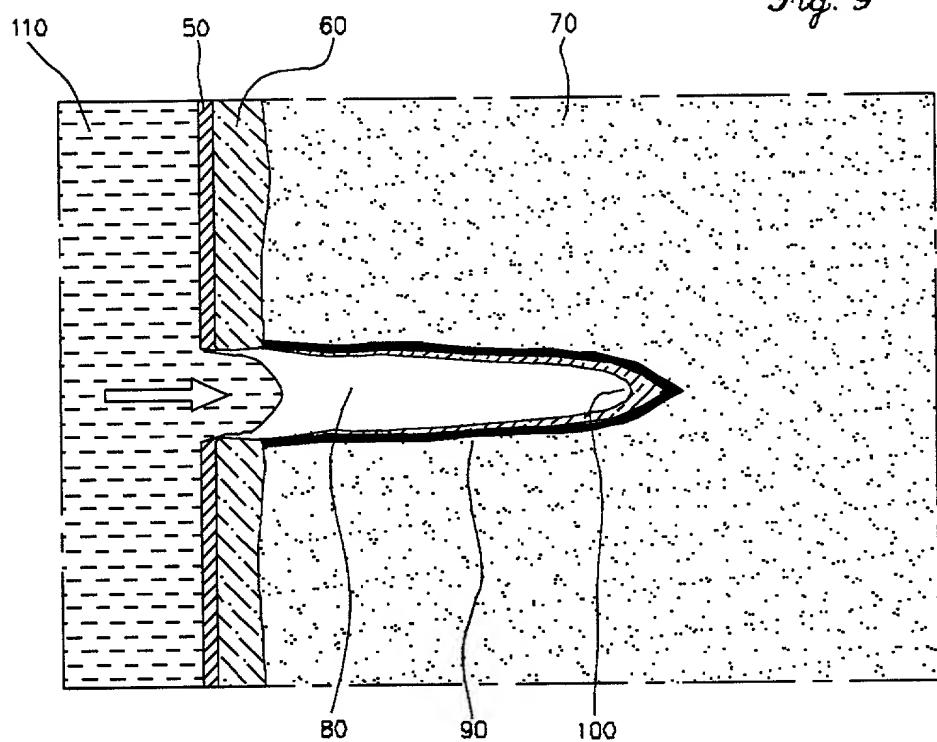


Fig. 10

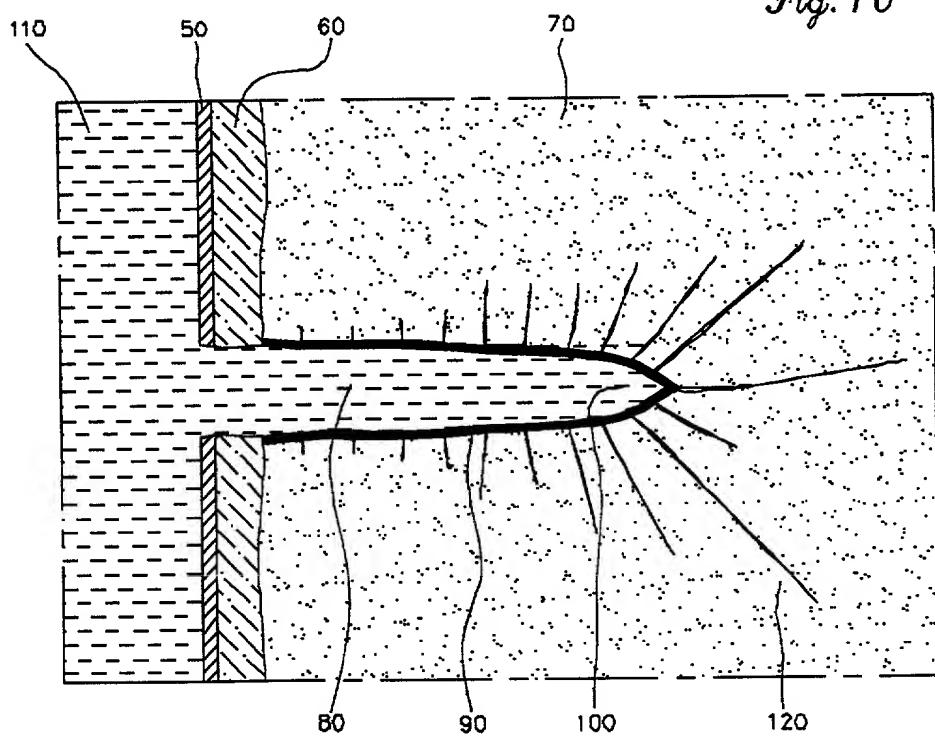


Fig. 11

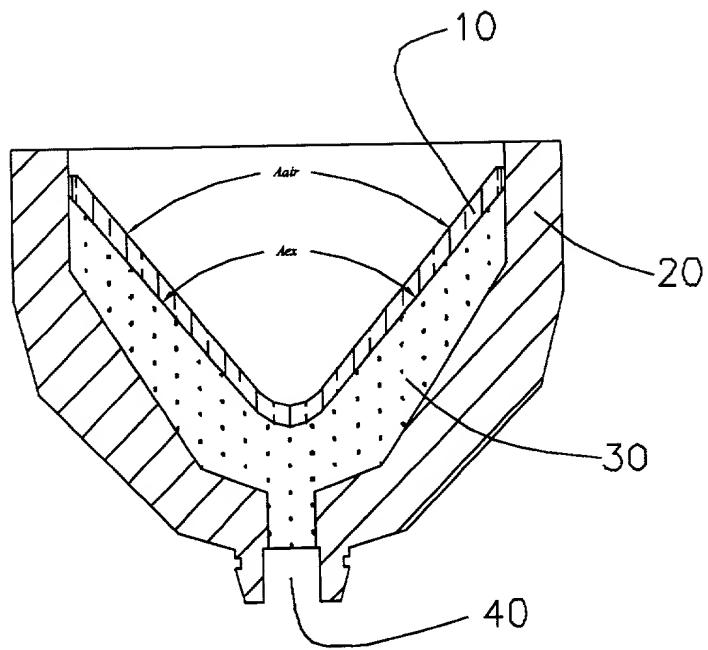


Fig. 12

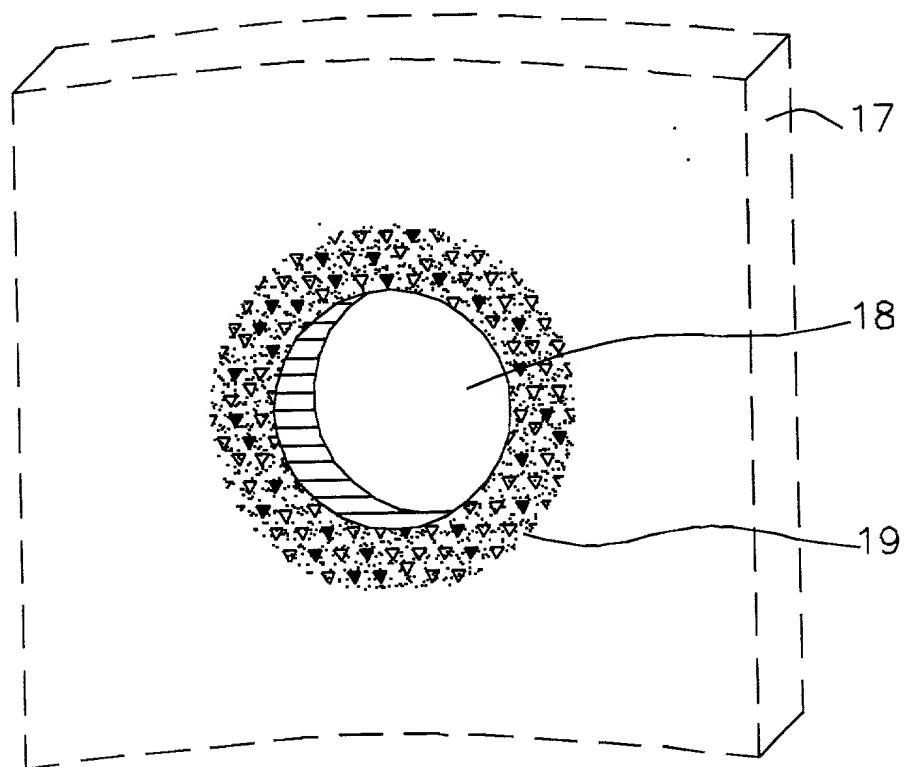


Fig. 13

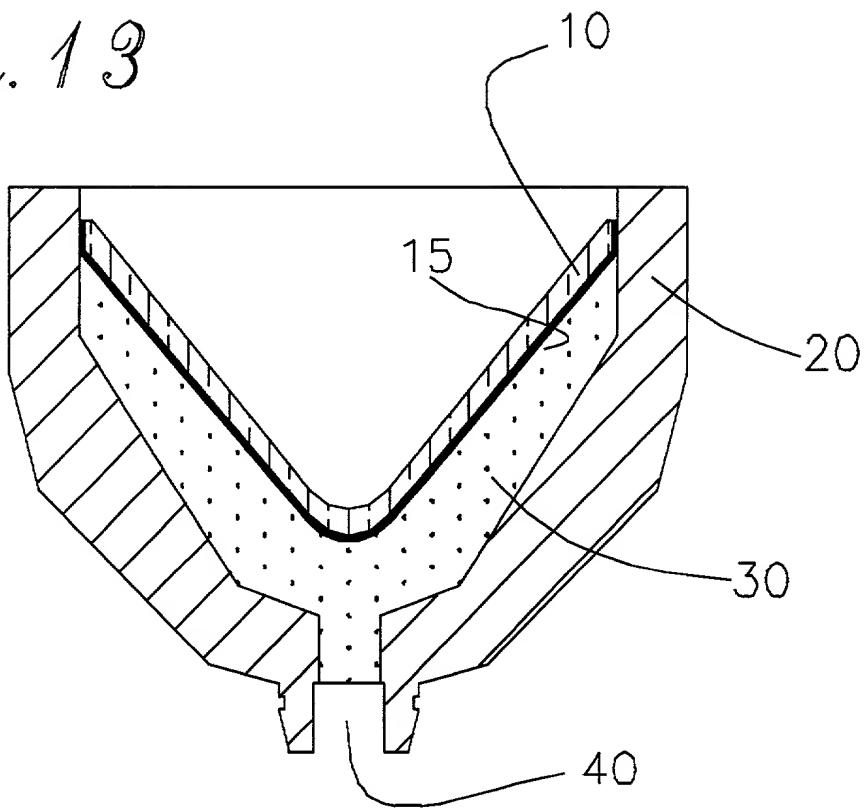
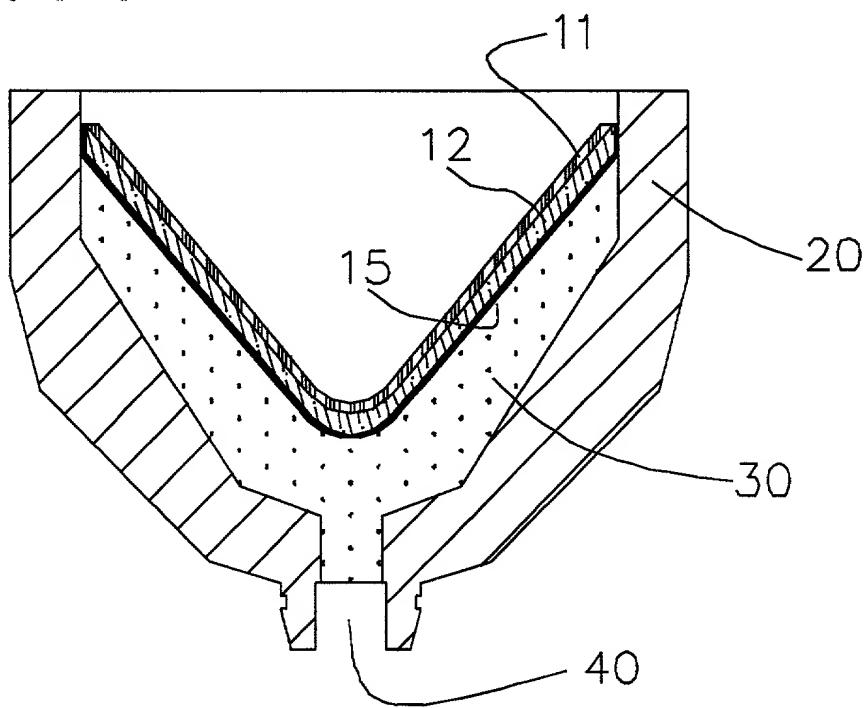


Fig. 14



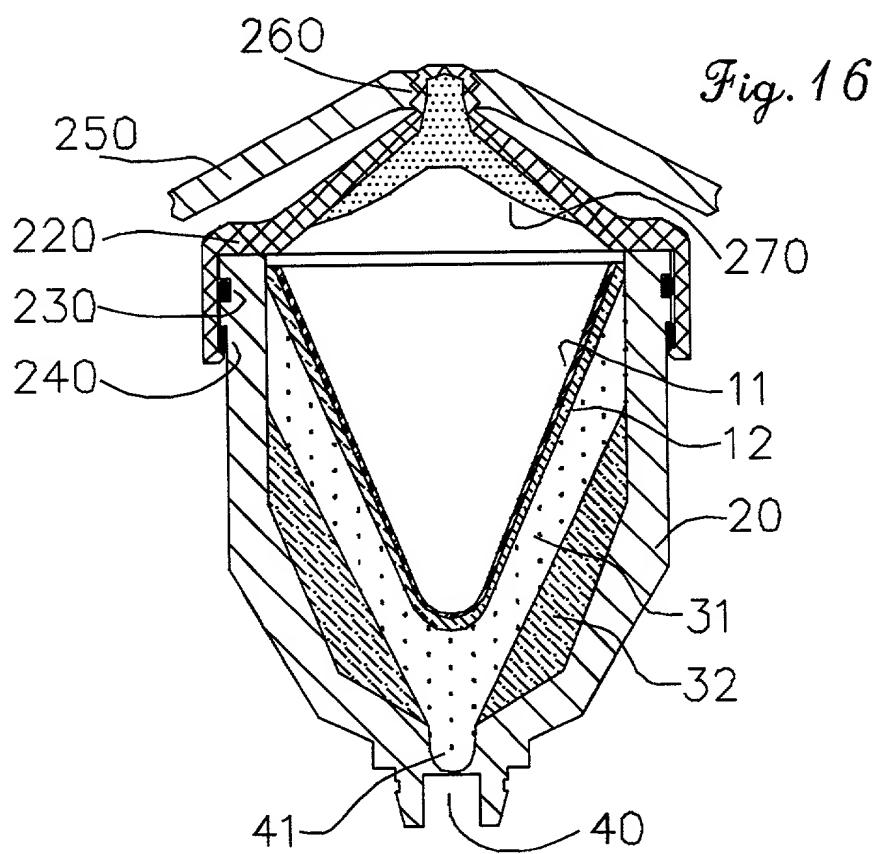
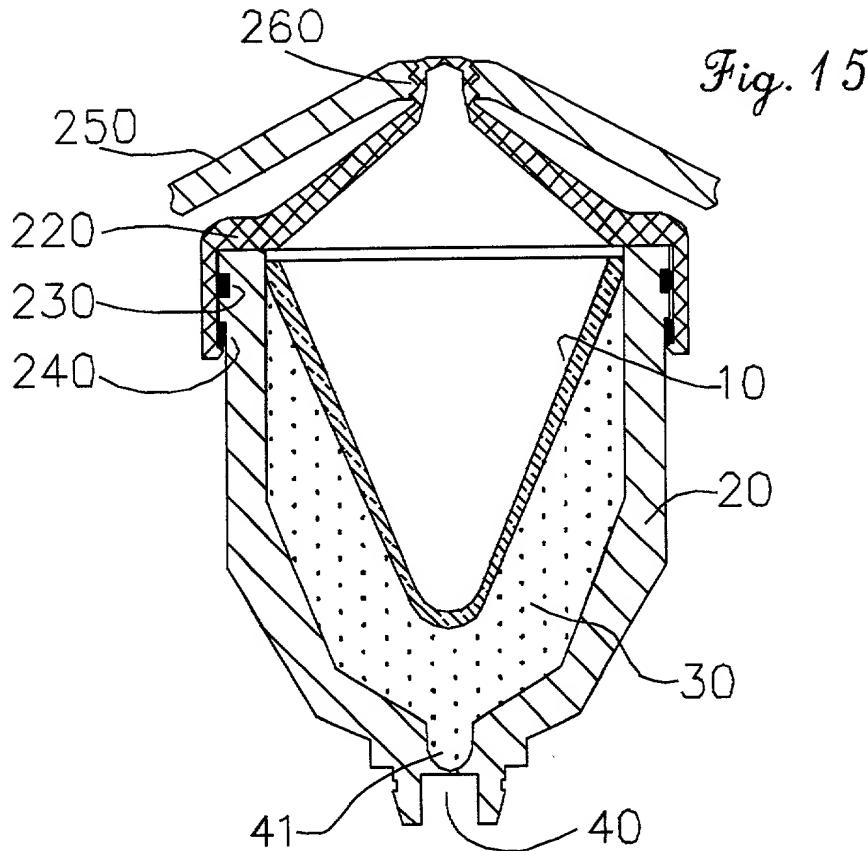


Fig. 17

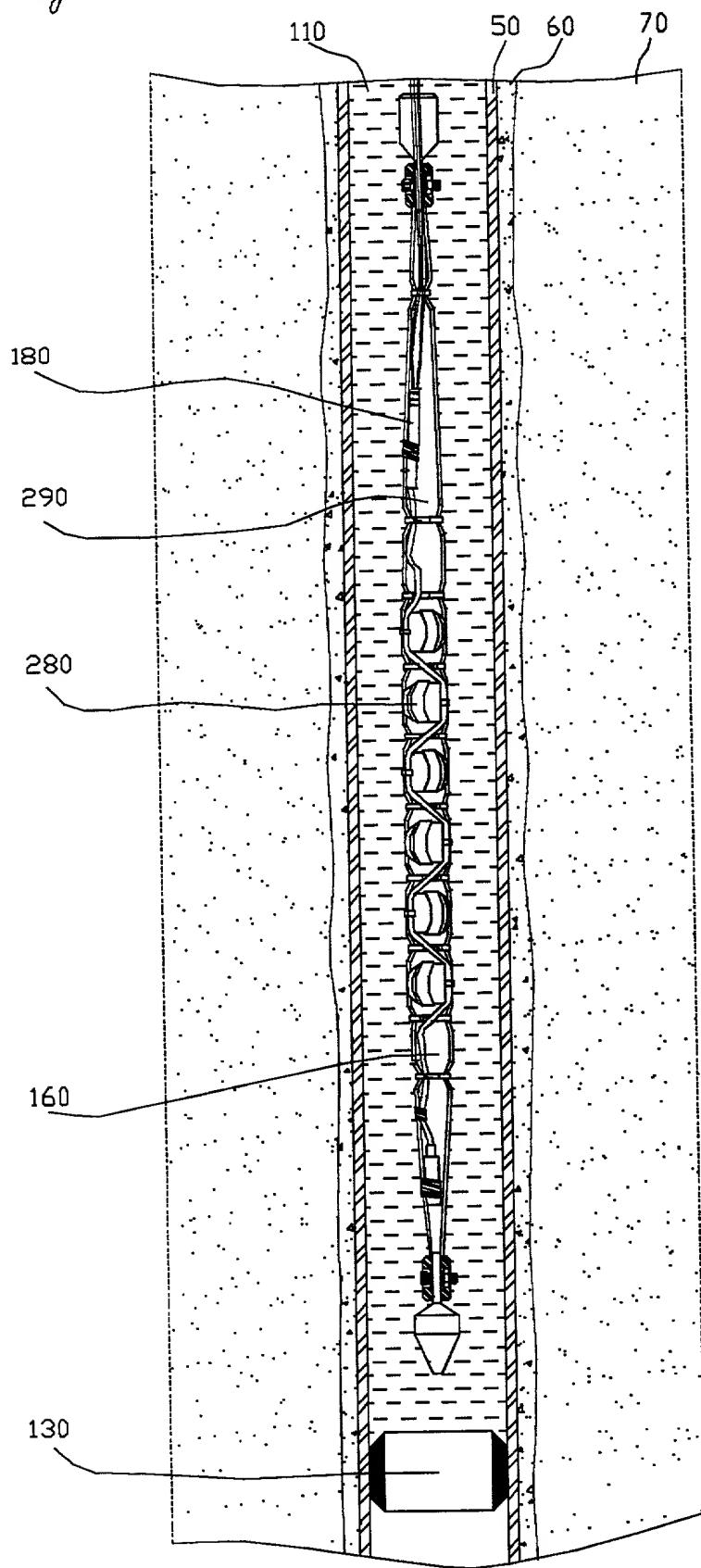


Fig. 18

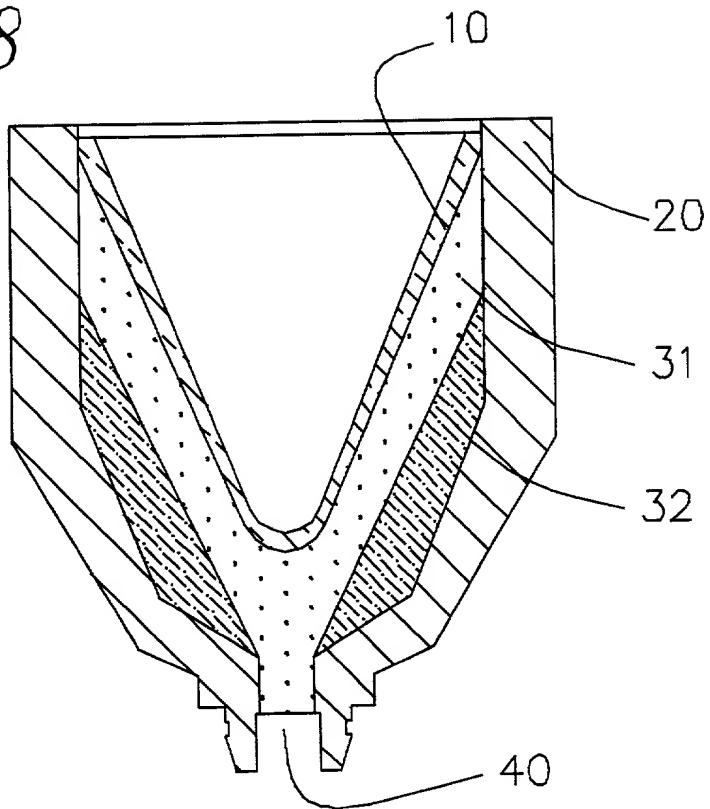


Fig. 19

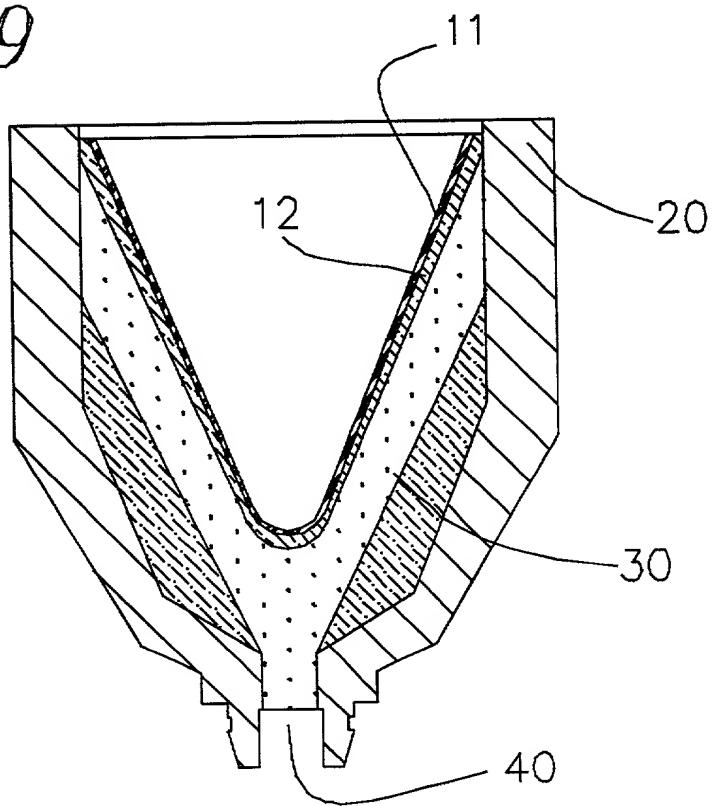


Fig. 20

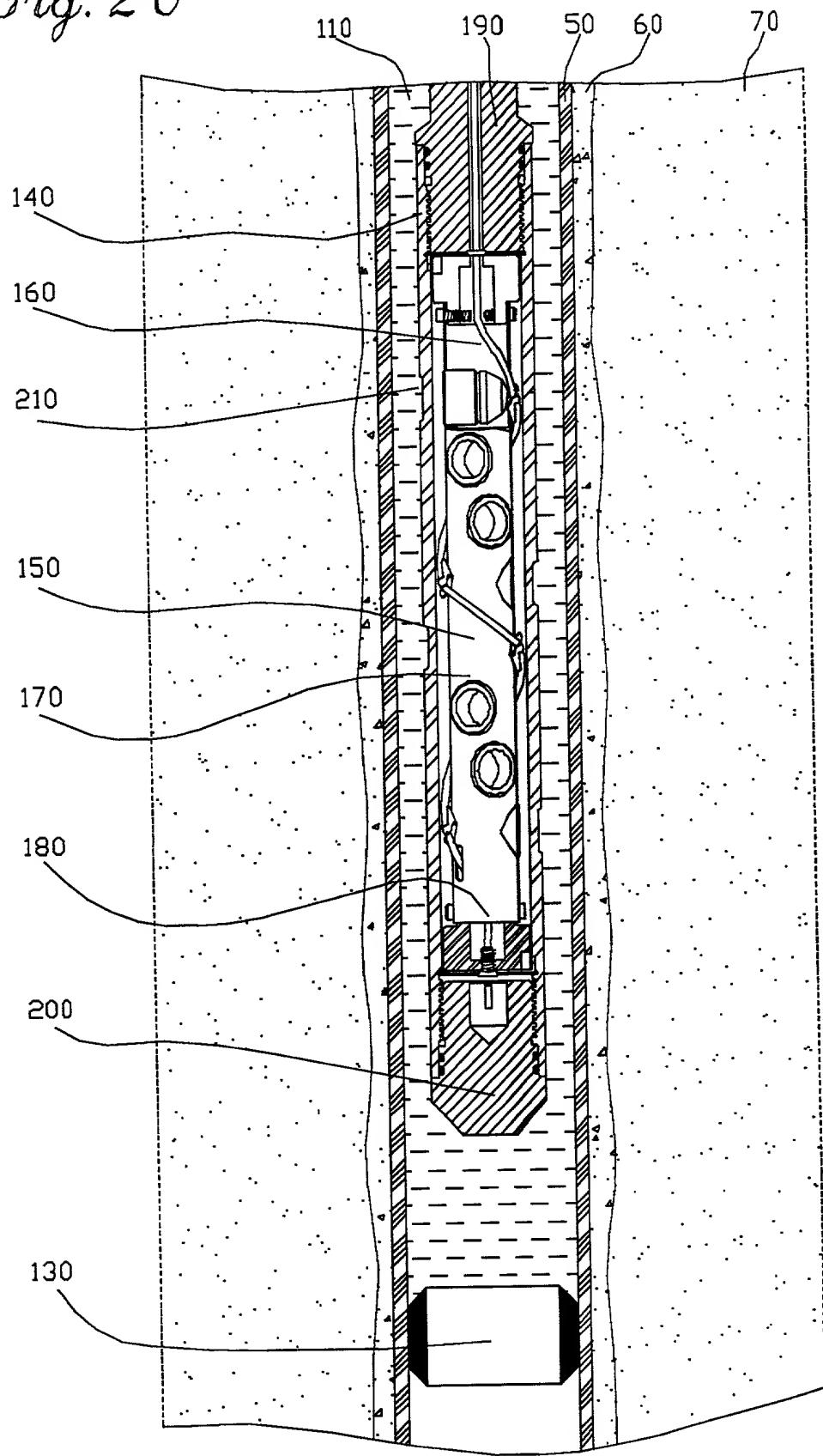


Fig. 21

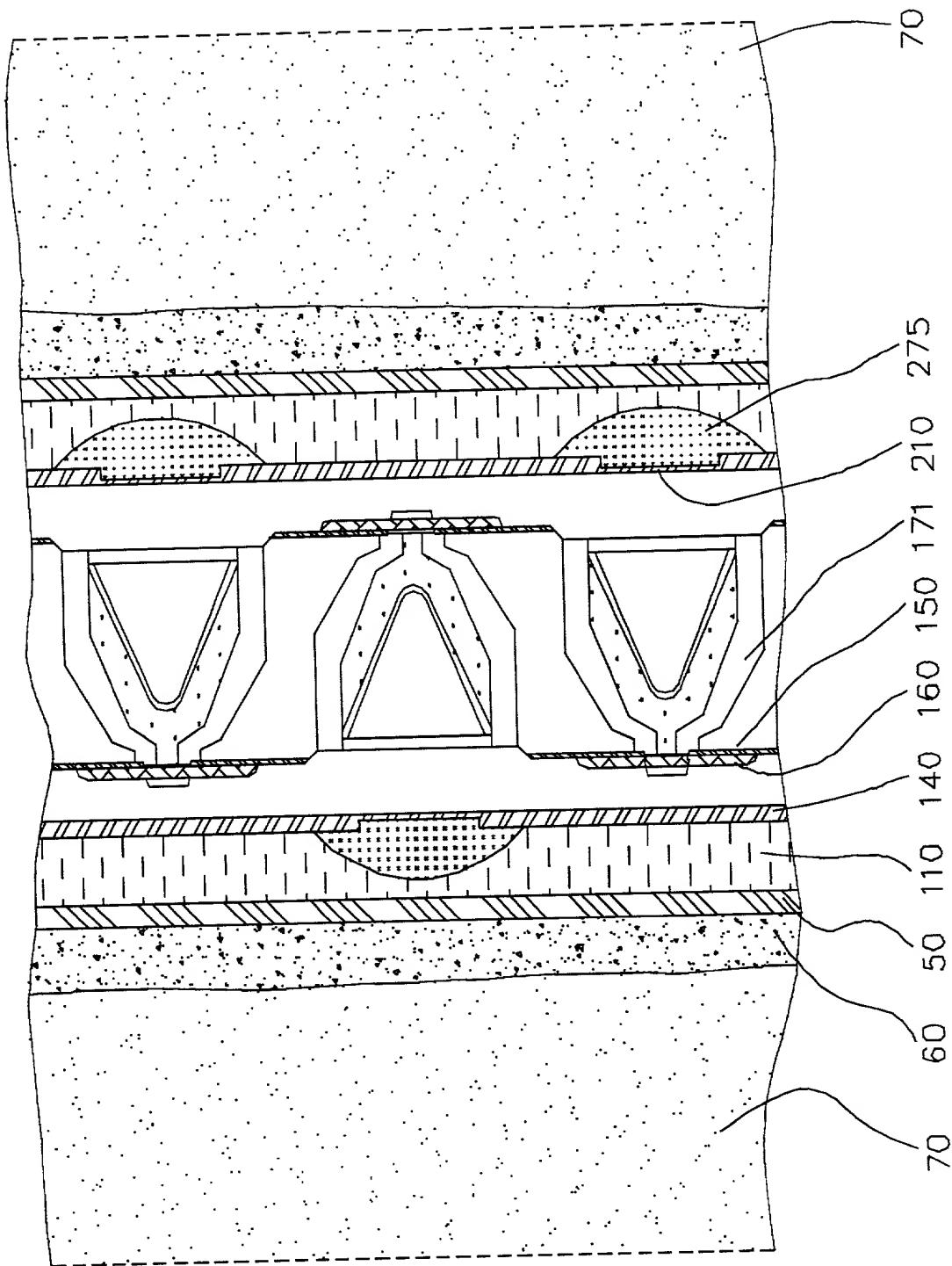


Fig. 22

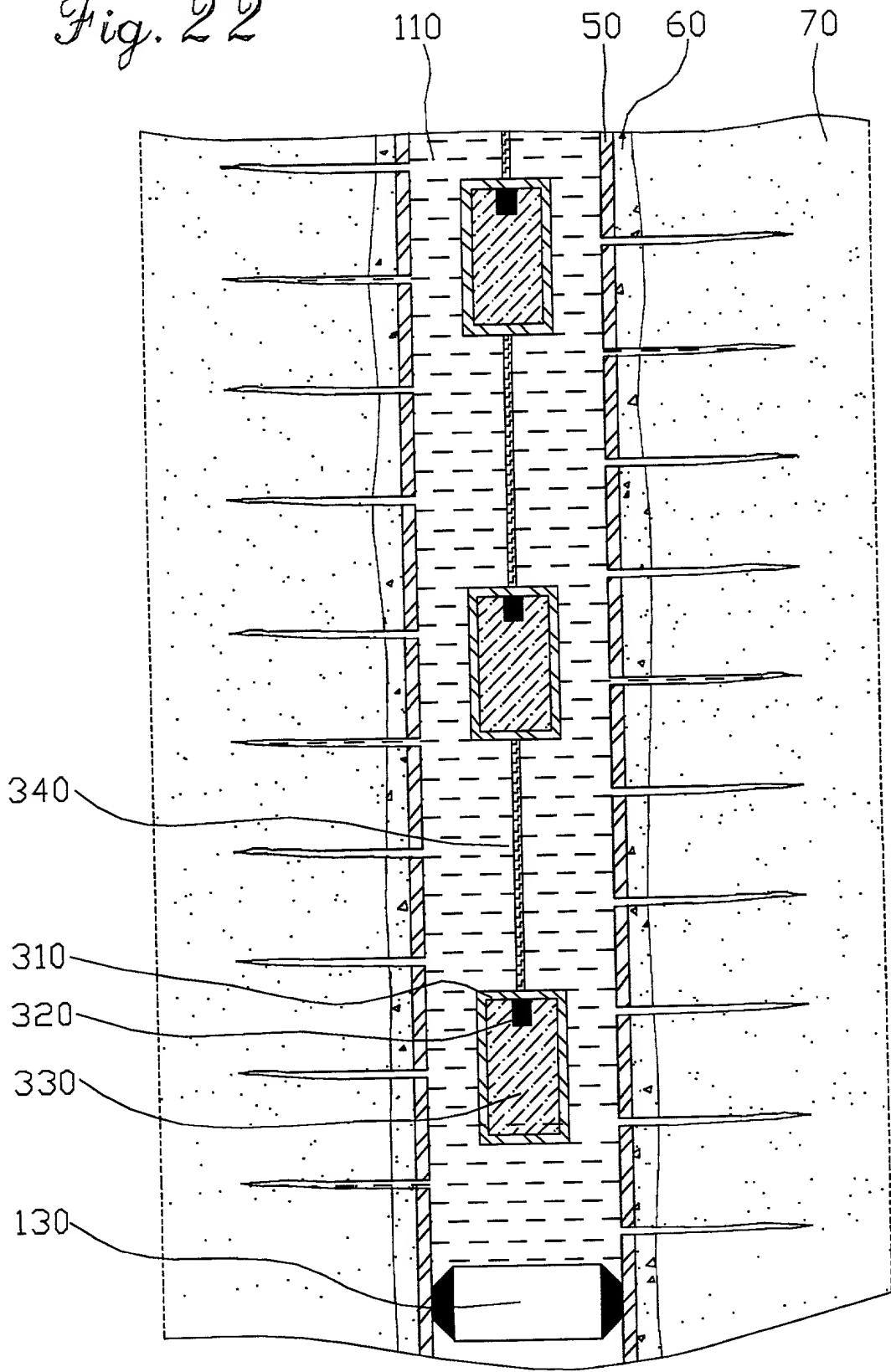


Fig. 23

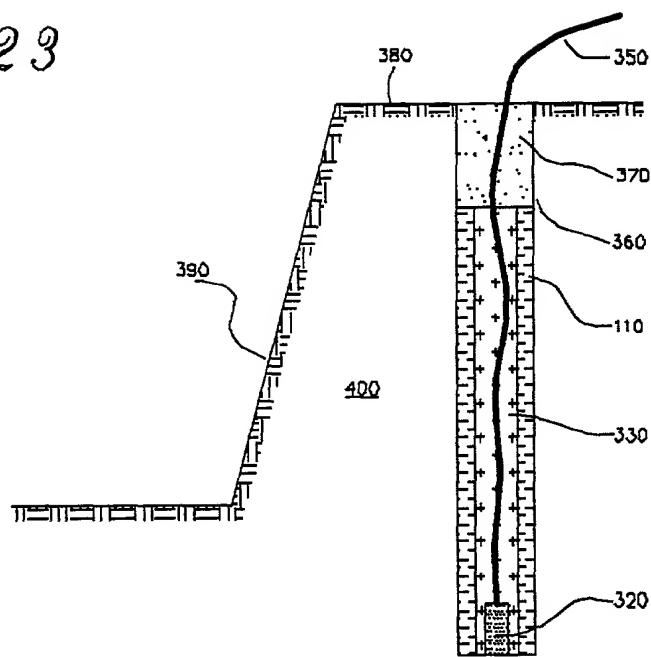


Fig. 24

